

Hybrid Approach for Modeling Chemical Kinetics and Turbulence Effects on Combustion-Instability, Phase I

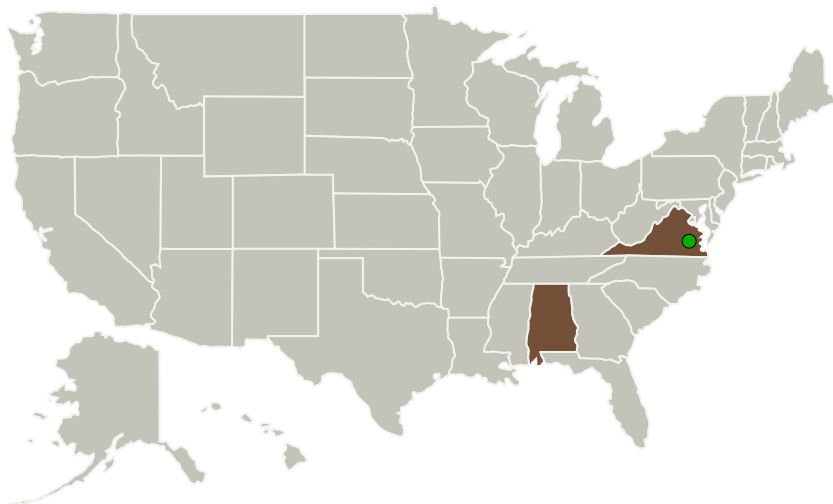
Completed Technology Project (2011 - 2011)



Project Introduction

Combustion instabilities pose a significant technical risk in the development of liquid and solid rocket motors. Much of the effort in modeling combustion instabilities has focused either on systems-level tools, or use of detailed computational fluid dynamics (CFD) to simulate all the involved processes. The important effects of finite-rate chemical kinetics and turbulence-chemistry interactions have been neglected in combustion instability modeling. In this SBIR project, CFD Research Corporation (CFDRC) will team up with Gloyer-Taylor Laboratories (GTL) to develop a hybrid approach by combining CFD capabilities with a systems-level instability modeling approach, the latter based on the Universal Combustion Device Stability (UCDS) process. These capabilities will be used to quantify the effects of finite-rate chemistry and turbulence-chemistry interactions on combustion instabilities. In Phase I, feasibility of the proposed approach will be demonstrated by combining 2-D Reynolds Averaged Navier Stokes and Large Eddy Simulation computations with the UCDS framework. In Phase II, the instability analysis will be enhanced by coupling: (1) 3-D CFD analysis; and (2) Improved UCDS process with more accurate treatment of boundary conditions and the flame. The proposed approach will enable an accurate combustion instability analysis of rocket motors, gas turbine combustors, and ramjet and scramjet engines.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Alabama	Virginia

Project Transitions

▶ **February 2011:** Project Start

✓ **September 2011:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138604>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

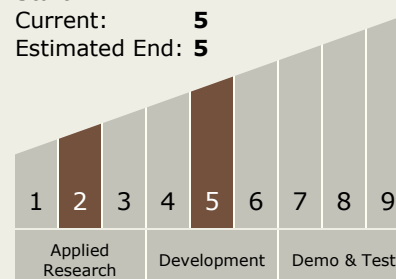
Carlos Torrez

Principal Investigator:

Ranjan Mehta

Technology Maturity (TRL)

Start: 2
Current: 5
Estimated End: 5



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.7 Computational Fluid Dynamics (CFD) Technologies

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System